SYSTEM AND METHOD FOR PROVIDING HIGH VACUUM REMEDIATION

BACKGROUND OF THE INVENTION

[0001] The present disclosure relates generally to a system and method of providing high vacuum remediation of contaminants within a site.

[0002] Improper handling and storage of petroleum and other hazardous chemicals can result in leaks and spills and pose a serious threat to the quality of the environment. Petroleum, additives and a variety of industrial chemicals have been discovered in many groundwater supplies. In some wells, only trace quantities have been discovered; in others, levels have exceeded Federal and State drinking water standards. Hundreds of drinking water supplies have been closed because of excessive chemical contamination.

[0003] Water contamination is only one consequence of poor handling practices. Mismanagement of some substances may pose occupational hazards, present a fire or explosion risk, or result in a release of odors or fumes with serious public health and environmental consequences to the neighboring community.

[0004] Gasoline, which fuels the millions of automobiles we all drive each day, is highly flammable and can flash violently when ignited. Gasoline and many other hazardous chemicals when inhaled can cause drowsiness, nausea, and other adverse health effects.

[0005] Once a chemical soaks into the ground, it disperses and may dissolve and contaminate a water supply for many years. Cleanup is often difficult and it is usually expensive.

[0006] Therefore, what is needed, is a system and method to effectively remove such hazardous liquids from any groundwater supplies.

SUMMARY OF THE INVENTION

[0007] The present disclosure provides a system and method of providing remediation of contaminants within a site.

[0008] Therefore, in accordance with the previous summary, objects, features and advantages of the present disclosure will become apparent to one skilled in the art from the subsequent description mid the appended claims taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a process flow diagram of the preferred embodiment;

[0011] Fig. 2 is a side view of the preferred embodiment;

[0012] Fig. 3 is another side view of the preferred embodiment;

[0013] Fig. 4 is a top view of the preferred embodiment;

[0014] Fig. *5* is a front and back view of the preferred embodiment along with the trailer;

[0015] Fig. 6 is a front and back view of the preferred embodiment without the trailer;

[0016] Fig. 7 is three views of the knock-out tank of the preferred embodiment; and

[0017] Fig. 8 is three views of the product tank of the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] The present disclosure can be described by the embodiments given below. It is understood, however, that the embodiments below are not necessarily limitations to the present disclosure, but are used to describe a typical implementation of the invention.

[0019] Fig. 1 illustrates a process flow of the preferred embodiment. In this embodiment, a site has diesel fuel that leaked underground from a diesel fuel storage tank. In addition, this embodiment is typically used for other Light Non-Aqueous Phase Liquid (LNAPL) remediation. An Internal Combustion Engine (ICE) unit **100** is used to produce a vapor line to a knock-out tank **102** and a recovery tank **104**.

[0020] Both the knock-out tank **102** and the recovery tank **104** are kept under vacuum pressure. In addition, the vapor line extends from the knock-out tank **102** to a recovery well **106** and draws out a mixture of product, vapor and water. Note that more than one vapor line can extend to many recovery wells at the same time although only one is shown in this embodiment. Note also that a slug mitigating liquid lifter **10** is used to transfer the mixture to the knock-out tank **102**. The slug mitigating liquid lifter **10** uses a coiled long hose to help decrease the amount of slope of the rise. The decreased slope in turn helps keep the water and product separated. In contrast, a large rise would increase the amount of back and forth movement of the mixture and thus cause more of the mixture to combine.

[0021] Once the mixture of product, vapor and water is drawn up to the knock-out tank **102**, the product and water stay separated because of the immiscibility of the water and product. Product and water separation is dependent upon retention time and gravity. A baffle between the entry point and product exit points of the knock-out tank **102** increases the retention time of the fluids in the knock-out tank **102**. Adjustable float switches control the level of the product and water interface in the knock-out tank **102** such that the product is allowed to accumulate in the knock-

out tank **102** until such time as a sufficient volume has accumulated to reach the recovery line **103** to the recovery tank **104**. Since the product stays on top of the water in this embodiment and both tanks **102** and **104** are under pressure vacuum, the product recovery line **103** carries product from the knock-out tank **102** to the product recovery tank **104**. The product then is transferred to a product storage tank **118** through a product line via a transfer pump **12** that is controlled by a series of level switches on the recovery tank **104**. Because the switches that control the level of the product and water interface in the knock-out tank **102** are adjustable, the knock-out tank **102** and recovery tank **104** can be configured to separate product and water as described above or they can be set to manage all produced fluids as total fluids without separating the product and water.

[0022] Moreover, since the water stays on the bottom of the knock-out tank **102**, a valve at the bottom of the tank **102** allows the water to be pumped via a transfer pump **202** to a set of parallel filters **108**. The water then travels to a series of filters **110** and then into a clay filter **112** and a carbon filter **114**. Once the water completes this filtration process, the water is transferred to a sanitary sewer or other disposal option **116**. Although a particular example of filter sets is shown, the set of filters can include any combination of or none of the parallel, series, clay and carbon filters and still remain within the scope of the invention.

[0023] Additionally, some of the gas product is recovered by the ICE **100** and used as fuel for the engine. The ICE **100** in turn bums off exhaust similar to most internal combustion engines.

[0024] Now turning to Fig. 2, a trailer **200** is shown to house the preferred embodiment. Knock-out tank **102**, slug mitigating liquid lifter **10**, and product tank **104** are shown side by side along with ICE **100** as shown in Fig. 1. A filter **108** is shown which could be a set of parallel filters and/or a set of series filters. The filter **108** is connected to the tanks **102** and **104** by a set of pumps **202**. In addition, a particulate filter **204** is shown that removes water from a vapor hose that originates at the ICE **100** and ends up at the top of knockout tank **102** and product tank **104**. A liquid propane tank **206** is also shown that is used to fuel the ICE **100**. Initially, the ICE **100** will most likely use the propane tank **206** as fuel, and then use a combination of some of the gas product recovered and the propane as fuel as the process continues. Moreover, another filter **208** is enclosed within the ICE **100** that also helps remove water from the vapor line. Further, this embodiment shows a toolbox **210**.

[0025] Fig. 3 also shows the trailer **200**, the knock-out tank **102**, the manifold **203**, the slug mitigating liquid lifter **10**, the ICE **100**, the filter **108**, the set of pumps **202**, the particulate filter **204**, the liquid propane tank **206**, and the toolbox **210**.

[0026] Fig. 4 shows the top view of the preferred embodiment. As in the other figures, the trailer **200** is shown to house the slug mitigating liquid lifter **10**, the knock-out tank **102** and the product tank **104**. In addition, the filters **108** are shown as they are connected through a hose to the set of pumps **202** to the knockout tank **102** and the product tank **104**. In addition, the particulate filter **204** is shown along with the vapor hose that originates at the ICE **100** and ends up at the knock-out tank **102** and the product tank **104**. Additionally, the toolbox **210** is also

shown in this figure.

[0027] Fig. 5 shows the front and back view of the embodiment along with the trailer **200**. The knock-out tank **102**, the slug mitigating liquid lifter **10** and the product tank **104** are shown positioned on the trailer **200** on the front and back view, along with the toolbox **210** on the back view. Moreover, the set of filters **108** is also shown on the front view.

[0028] Fig. 6 shows the front and back view of the embodiment without the trailer to show more detail of the tanks **102** and **104**. In particular, slug mitigating liquid lifter **10** is shown that brings in the mixture of product and water from the recovery wells. The intake hose also attaches to the slug mitigating liquid lifter **10** attaches to the knock-out tank **102** near the top of the tank **102**. Further, a connection **103** is shown between the knock-out tank **102** and the product tank **104** to allow product to flow from the knock-out tank **102** since the water settles near the bottom of the knock-out tank **102** and the product separates near the top of the tank **102**, as controlled by the interior baffle in the knock-out tank **102** and the adjustable float switches at various locations along the side of knock-out tank **102** that control the level of the product and water interface such that product accumulates near the top of the knock-out tank **102**. The connection **103** is positioned on the knock-out tank **102** to allow only product to flow into the product tank **104** when the system is operated in product and water separation mode. Moreover, the levels of product and water are maintained in order to allow only product to flow to the product tank **104** when operating in product and water separation mode. Alternatively, the adjustable float switches on knock-out tank **102** that control the product and water interface level in knock-out tank **102** can be adjusted such that either total fluids are contained in and subsequently pumped from knock-out tank **102** and recovery tank **104** is not used, or the switches can be adjusted such that total fluids are transferred from knock-out tank **102** to recovery tank **104** and then pumped from recovery tank **104**.

[0029] Fig. 7 shows three more views of the knock-out tank **102** to show more detail of how a knock-out tank can be configured.

[0030] Fig. 8 shows three more views of the product tank **104** to show more detail of how a product tank can be configured.

[0031] It is understood that several modifications, changes and substitutions are intended in the foregoing disclosure and in some instances some features of the invention will be employed without a corresponding use of other features. For example, instead of disbursing the water to a sanitary sewer, the water could be disbursed to a storm sewer, discharged as surface water, captured in a tank for later treatment, re-injected into the sub-surface, as well as other methods of removal. In addition, the invention can also use other types of vacuum pumps other than the ICE. For example, a liquid ring pump, or other types of vacuum pumps can be used. Other modifications, changes and substitAccordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.